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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO DOWEL JOINTING

(71) I, ADOLF HELD, of German Nationality, of 7201, Schura, Near Tuttlingen, Germany, trading as Adolf Held, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed to be particularly described in and by the following statement:—

The invention relates to a method whereby workpieces consisting of wood or woodlike materials can be jointed in a simple and rapid manner.

The joiner usually provides, for the purpose of jointing laminar components, mitres at the joint position, which are glued together and stabilised by the use of dowels or tongues inserted into bores or grooves. This technique has changed little over a period of centuries. Although glues have been developed manufactured from plastics materials, e.g. of polyvinyl acetate, epoxy-polyester resin and the like, which set in a relatively short time, and also dowels or tongues consisting of plastics or metal, the actual jointing technique has changed very little. It is always necessary for the parts to be jointed together to be provided with very accurately fitted bores, grooves and dowels, pins or tongues.

It is a main object of the present invention to provide a method whereby, in contra distinction to those hitherto known, it is not important for the bores or the like cavities and the pins and dowels to be placed in precisely predetermined positions. Consequently it can be performed by unskilled, or at most semi-skilled labour, without detriment to the quality of the joint. In fact the strength of the joint is considerably increased, and simultaneously the standing time required for the setting process, and also the working time necessary for the preparation, are substantially reduced.

According to the present invention a method of jointing workpieces consisting of wood or of woodlike materials, is characterised by forming intercommunicating cavities, such as bores or grooves, in the workpieces in the region of the joints, and introducing into the cavities a liquid or paste-like rapid-setting material.

The principal suitable materials for jointing workpieces consisting more particularly of wood or woodlike materials are thermoplastic plastics, such as polyamide, polycarbonate, polystyrene, polyethylene.

The large number of plastics materials available makes it possible to adapt the joint to the most widely varying requirements. Thus it is possible to construct highly rigid joints, and also highly resilient joints, as determined by the plastics selected. Furthermore, even joins of hingelike construction can be produced, if a highly resilient material, e.g. rubber, is introduced as the jointing agent.

The plastics, liquefied at a specific temperature, may be introduced by injection moulding or compression moulding. In the case of jointing workpieces consisting of woodlike material thermoplastic plastics have been found convenient which have a liquid or at least pasty aggregate condition at a temperature of 200°C to 250°C and at a pressure of 50 to 400 atm.

It is however also possible to introduce liquefied jointing materials at normal pressure.

Finally there is the possibility of using jointing agents consisting of a plurality of components, known *per se*, which only set when the two components are united. In this case the two components should be united only when they are introduced into the cavities of the workpieces to be jointed, whereupon they set rapidly, and a rigid or resilient joint is then produced, depending upon the choice of the initial substances.

Whereas drying times of 2 to 8 minutes have been calculated for joinery work, even where the most modern glues were used, the method according to the invention permits the setting time, i.e. the standing time, to be reduced to less than 10 seconds. The joint constructed in this way is furthermore far stronger; this is

attributable to the fact that the fixing agent fills all cavities, bores, seams and pores in the region of the joint positions. This advantage is gained more particularly with the use of porous materials, such as wood chipboards, which are today in large scale use in the furniture industry.

A further advantage is that the method according to the invention makes it possible to respect much narrower tolerances, although it can be performed by unskilled or semiskilled labour. Thus it is only necessary to introduce the parts to be jointed into a suitably constructed apparatus, for which purpose no special expert knowledge is required. The said apparatus consists, e.g., of an injection moulding, pressure moulding or compression moulding machine known *per se*, having one or a plurality of devices supported for movement into and out of cooperative relation with a cavity appropriate thereto in a workpiece held by clamping jaws and arranged to introduce rapid-setting liquid or paste-like material into the cavity.

In one embodiment of the invention, the clamping jaws are movable relative to one another by compressed air or hydraulic cylinders. In order that the generally liquid jointing agent, when introduced under pressure, does not emerge through the seams of the joint positions, the clamp jaws are conveniently constructed in such a manner that they cover the seams of the workpieces to be jointed in the region of the joint positions.

Such apparatus is particularly well suited for series production. However, to enable them to be as universal as possible in their application and utilisation, the outlet nozzles arranged above and/or at the side of the clamping tool are constructed for swivelling and/or vertical adjustment.

The invention has outstanding importance in the jointing of relatively thin laminar workpieces arranged mutually at an angle, more particularly if the same consist of porous material — e.g., wood chipboards. For this purpose the clamping jaws comprise a stationary jaw having abutment surfaces oriented mutually at an angle corresponding to the joint angle, and a clamping jaw displaceable with respect to the stationary jaw and having pressure surfaces likewise oriented mutually at an angle.

The technique according to the invention, according to which the workpieces to be jointed are formed in the region of the joint position with one or a plurality of mutually merging cavities, such as bores, grooves or the like, oriented transversely to the joint surface and filled with hardened material, leads to totally novel joint elements.

First of all, it is possible to inject in one work stage elements consisting of plastics or the like, in corresponding manner to the tongue or dowel joints hitherto known. For this purpose cavities in the form of grooves or bores oriented perpendicularly or at an angle to the joint surfaces are provided in the joint surfaces of the workpieces to be jointed. It is also possible, in novel manner, to give the grooves a dovetail-shaped cross-section, whereby the strength of the joint is considerably increased. Furthermore, grooves mutually intersecting in the region of the joint surfaces can be filled with the fixing agents.

Lastly, a type of joint has been developed, wherein grooves mutually merging, have been milled, preferably on the external surface of the workpieces to be jointed, into which a plurality of communicating bores penetrating both the workpieces open. An extraordinarily stable corner joint can be obtained by this means.

The method according to the invention simplifies and improves not only the jointing of laminar workpieces, but also the jointing of fillets or strips, as used more particularly in the manufacture of chairs, frames or the like. It is required to joint together three or more fillet-shaped workpieces, e.g. in the region of a chair leg, it is merely necessary to provide a central workpiece with a filling bore into which there open a plurality of mutually connected bores penetrating the other workpieces. By introducing the fixing material in the manner according to the invention, the three parts become jointed with a strength which was hitherto unobtainable by the traditional gluing technique.

Should it be required to construct an even stronger joint, according to another proposal of the invention an additional reinforcement in the form of wires or the like may be provided, which are simultaneously embedded in the injected plastics.

Whereas the proposals discussed hereinbefore relate to permanent joints, detachable joints according to the present invention are discussed hereinbelow. A component for constructing a detachable joint is, e.g., the screw, and in the joinery trade the wood screw. Since screwthreads can only be cut in extremely hard wood, the wood screw has only attained very minor importance in joinery technique. For this reason it has been replaced by metal fittings.

It is proposed by the invention, instead of the said metal fittings, to provide one of the two workpieces of wood or woodlike material to be jointed with one or a plurality of bores having female screwthreads formed by a liquid or paste-like rapid-setting material introduced in known manner around cores located in the bores, whereas the second workpiece is provided with bores corresponding to the said screw-threads, for the passage of connecting bolts.

A further possibility of constructing a structure comprising two workpieces of wood or woodlike material arranged to be detachable one from the other consists in providing one

of the two workpieces with bores into which bolts formed by a liquid or paste-like rapid-setting material and having T-shaped headpieces projecting beyond the surface of the workpiece, and the other workpiece with locking members formed by a liquid or paste-like rapid-setting material incorporated in bores and co-operating with the bolts.

Connecting elements of this type consisting of metal are already known. However, they again necessitate a highly accurate treatment of the workpieces which can be performed only by skilled labour.

In order that the invention may be more clearly understood some embodiments thereof will now be described, by way of example, with reference to the accompanying drawings in which:—

Fig. 1 is a plan view of an injection moulding apparatus according to the present invention,

Fig. 2 shows a side elevation of the apparatus of Fig. 1,

Figs. 3 to 6 show, in perspective, mitre joints constructed according to the invention,

Fig. 7 shows a perspective view of a frame joint according to the invention,

Fig. 8 shows a joint according to the invention, constructed after the fashion of a cross tongue,

Figs. 9 and 10 show two further ways of jointing laminar workpieces according to the invention,

Fig. 11 shows a section of board having the plastics screwthread according to the invention, and

Figs. 12 and 13 show two workpieces which are to be detachably jointed together according to the invention.

Figs. 1 and 2 illustrate schematically a preferred embodiment of apparatus for performing the method of the invention. The apparatus exhibits a clamping tool having a stationary clamp jaw 1 and a clamping jaw 2 displaceable by means of a compressed air or hydraulic cylinder 5. Opposite the clamping jaw 2, of prismatic construction, is arranged a recess, corresponding thereto, of the clamping jaw 1, in such a manner that two laminar workpieces 3 and 4 to be jointed together can be clamped between the two jaws. At their joint position, the two workpieces to be jointed are provided with a groove 8 oriented perpendicularly to the mitre cut and penetrating the two workpieces 3 and 4, into which liquid plastics material is introduced under pressure through an injection nozzle 7. As Figs. 1 and 2 clearly show, the injection nozzle is supported by a vertically adjustable and laterally swivellable arm 6.

The apparatus according to the invention may be varied, and possibly augmented by further injection nozzles, according to the purpose for which it is used.

Figs. 3 to 10 illustrate a small selection of joints whose construction is made possible by the method of the invention. For instance, Figs. 3 and 4 illustrate tongue joints and angle tongue joints, which are constructed by injecting plastics material in the manner described above. The arrangement according to Fig. 6 is distinguished from that according to Fig. 3 by a dovetail-shaped cross-section of the joint tongue, which increases the strength of the joint.

Fig. 5 illustrates a corner joint, which it would have been impossible to construct with the hitherto customary means of the joinery trade. In this case the laminar workpieces 3^1 and 4^1 are provided in the region of their joint positions with flat superficial cavities 9, into which bores 10 penetrating the corner region of the two workpieces 3^1 and 4^1 issue on both sides. As directed, liquefield plastics material is introduced under pressure into the cavities and the bores, and after hardening produces an extraordinarily stable joint.

The frame joint illustrated in Fig. 7 of the drawing is also practicable for the first time by virtue of the technique according to the invention. Frame joints of this type are suitable, e.g., for the manufacture of chair frames, wherein the members 11 and 12 of the chair seat are to be jointed to the upper end 13 of the chair leg. The central part 13 is provided with a central bore 14, into which bores 15 and 16 through the parts 11 to 13 open. The plastics material injected into and having hardened in the boreholes 14 to 16 produces a heavy-duty dowel type joint of the parts 11 to 13.

Further variants of injection-moulded tongue joints of plastics materials are clearly shown in the Figs. 8, 9 and 10. The proposal of Fig. 8 represents a cross tongue joint, wherein the tongues 17 and 18 intersect in the region of the joint surfaces of the two workpieces 19 and 20.

In the embodiments according to Figs. 9 and 10, angled tongues 21, or obliquely arranged flat tongues 22, are used.

Whereas the embodiments discussed hereinbefore and illustrated in Figs. 3 to 9 serve for the fixed, nondetachable, jointing of two or more workpieces, proposals for the construction of detachable joints are illustrated in Figs. 11 to 13.

A fillet 23 illustrated in Fig. 11 is provided with a bore into which a female screwthread 24 of plastics material has been injection moulded in known manner around a core. If a high-strength plastics material is used for this purpose, a metal screwthread can be used instead of the customary wood screwthread without difficulty.

Another type of detachable joint is illustrated in Figs. 12 and 13. The workpiece according to Fig. 12 is fitted with plastics bolts 25 injection moulded into corresponding bores, whereof the protruding headpieces 26 have a

T-shaped cross-section, which can be engaged into the locking members 27, corresponding to them, in the second workpiece illustrated in Fig. 13. The locking members 27 are injection-moulded in slots in the workpiece illustrated in Fig. 13 by the use of two-part cores of suitable construction. They exhibit a top aperture 27*a*, into which the head 26 can be introduced, and a bottom cavity 27*b*, the dimension of which corresponds to the width of the neck 26*b*.

Jointing elements of this type may be used, e.g., instead of the fittings for beds hitherto known and made of metal.

WHAT I CLAIM IS:—

1. A method of jointing workpieces consisting of wood or of woodlike materials, characterised by forming intercommunicating cavities, such as bores or grooves, in the workpieces in the region of the joints, and introducing into the cavities a liquid or paste-like rapid-setting material.

2. The method according to Claim 1, wherein the rapid-setting material is a thermoplastic material, for example polyamide, polycarbonate, polystyrene, or polyethylene.

3. The method according to Claim 1, wherein the rapid-setting material is resilient in the set condition, e.g., rubber.

4. The method according to any one of Claims 1 to 3, wherein the rapid-setting material consists of a plurality of components which are only united when introduced into the cavities and then set rapidly, forming a rigid or resilient joint.

5. The method according to Claim 1, wherein the rapid-setting material is introduced into the cavities under pressure.

6. Apparatus for performing the method according to any one of Claims 1 to 5, comprising clamping jaws supported for relative movement into and out of clamping relation with a workpiece or workpieces including a cavity or cavities into which the rapid-setting material is to be introduced, and for each of said cavities a device supported for movement into and out of co-operative relation with the cavity appropriate thereto and arranged to introduce rapid-setting liquid or paste-like material into the cavity.

7. Apparatus according to Claim 6, wherein the clamping jaws are actuable by compressed air or hydraulic cylinders.

8. Apparatus according to Claim 7, wherein the clamping jaws are constructed in such manner that they cover the seams of the workpieces to be jointed in the region of the joint.

9. Apparatus according to any one of Claims 6 to 8, characterized in that the nozzle or nozzles is or are arranged above and/or at the side of the clamping jaws.

10. Apparatus according to any one of Claims 6 to 9, wherein the nozzle or nozzles is or are arranged for swivelling and/or vertical adjustment relative to the clamping jaws.

11. Apparatus according to any one of Claims 6 to 10, for jointing laminar workpieces arranged mutually at angles, wherein the clamping jaws comprise a stationary jaw having abutment surfaces oriented mutually at an angle corresponding to the joint angle, and a jaw displaceable with respect to the stationary jaw and having pressure surfaces likewise oriented mutually at an angle.

12. A structure comprising at least two workpieces of wood or woodlike material jointed by the method according to any one of Claims 1 to 5, characterized in that the workpieces are formed in the region of the joint with one or a plurality of mutually merging cavities, such as bores or grooves, oriented transversely to the joint surface and that the workpieces are connected by joints formed by a rapid-setting liquid or paste-like material injected into and allowed to set in the merging cavities.

13. A structure comprising laminar or fillet-shaped workpieces according to Claim 12, characterized in that the cavities consist of grooves arranged perpendicularly or at an angle in the joining surfaces of the workpieces.

14. A structure according to Claim 12 or Claim 13, characterized in that the grooves have a dovetail shaped cross-section.

15. A structure according to any one of Claims 12 to 14, characterized in that the cavities consist of grooves mutually intersecting in the region of the joint surfaces.

16. A structure according to any one of Claims 12 to 15, characterised in that the cavities consist of mutually merging grooves arranged at the external surface of the workpieces to be jointed, into which open a plurality of communicating bores penetrating both the workpieces.

17. A structure according to any one of Claims 12 to 16, comprising three or more fillet-shaped workpieces, characterized in that a central workpiece has a filling bore into which there open a plurality of bores mutually connecting the remaining workpieces.

18. A structure according to any one of Claims 12 to 18, characterized by reinforcing elements, e.g. wires, embedded into the jointing material.

19. A structure comprising two workpieces of wood or woodlike material arranged to be detachable one from the other, characterized in that one of the two workpieces has one or a plurality of bores having female screw-threads formed by a rapid-setting material introduced therein around a core, and the other workpiece has bores corresponding to said bores for the passage of connecting bolts.

20. A structure comprising two workpieces of wood or woodlike material arranged to be detachable one from the other, characterized in that one of the two workpieces has bores into which bolts formed by a liquid or paste-like rapid-setting material and having T-

shaped headpieces projecting beyond the surface of the workpiece, and the other workpiece has locking members formed by a liquid or paste-like rapid-setting material incorporated in bores and co-operating with the bolts.

21. A joint according to any one of Claims 13 to 20, characterized in that the workpieces to be jointed consist of wood chipboard or wood fibreboard.

22. A method of jointing workpieces of wood or woodlike materials substantially as herein described with reference to the accompanying drawings.

23. Apparatus for jointing workpieces of wood or woodlike materials constructed and arranged to operate substantially as herein described with reference to Figs. 1 and 2 of the accompanying drawings.

24. A structure comprising workpieces of wood or woodlike material jointed substantially as herein described with reference to any one of Figs. 3 to 13 of the accompanying drawings.

PAGE, WHITE & FARRER,
Chartered Patent Agents,
27 Chancery Lane,
London, W.C.2.
Agents for the Applicant.

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1203305 COMPLETE SPECIFICATION
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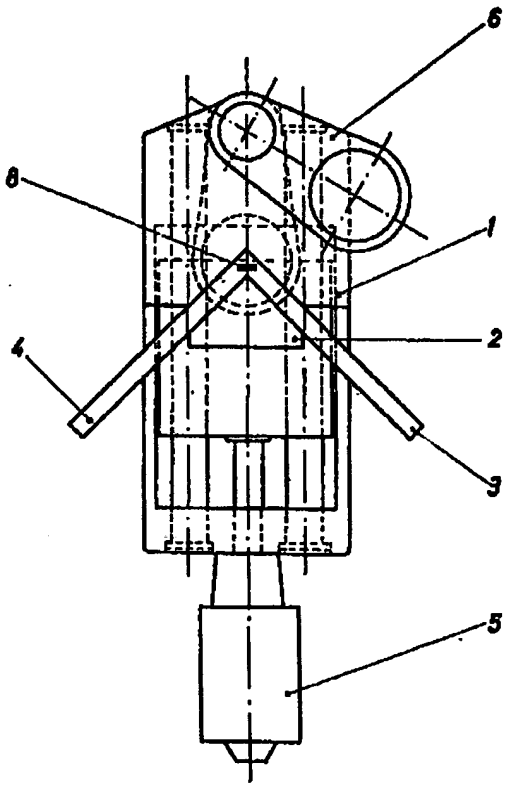

Fig. 1

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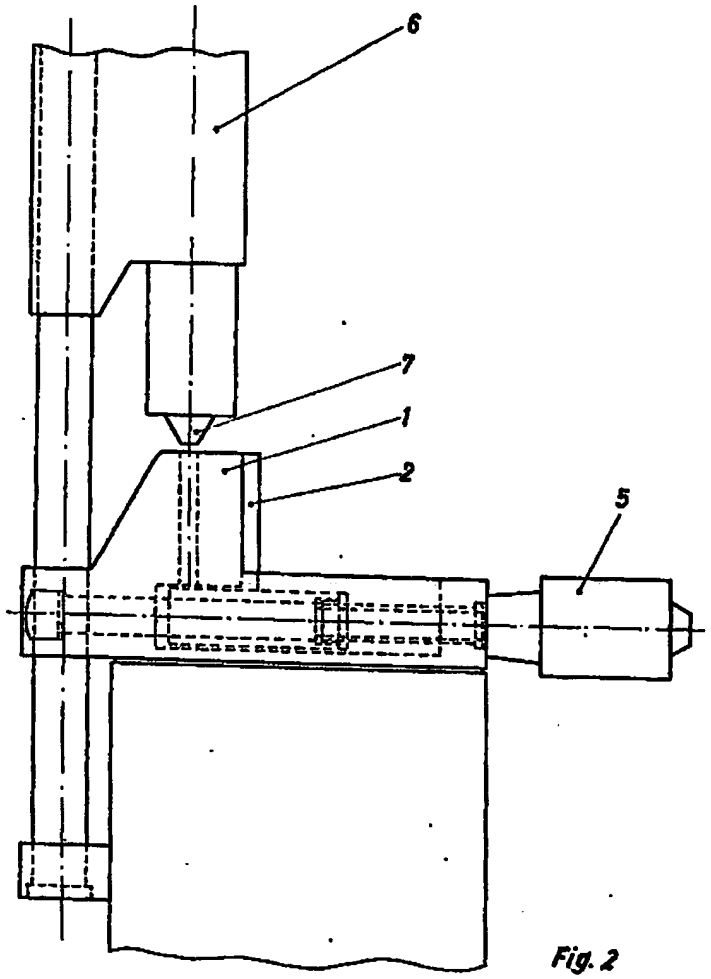

Fig. 2

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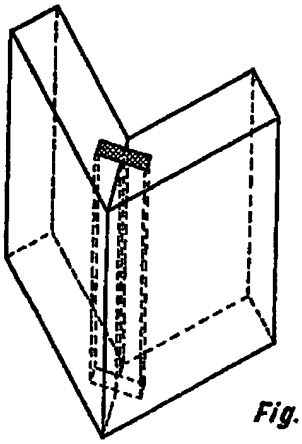

Fig. 3

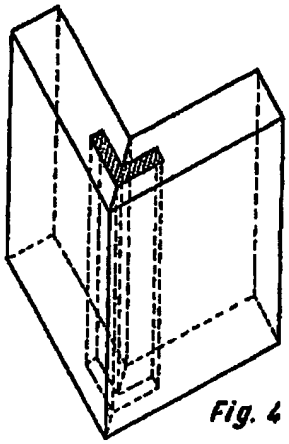

Fig. 4

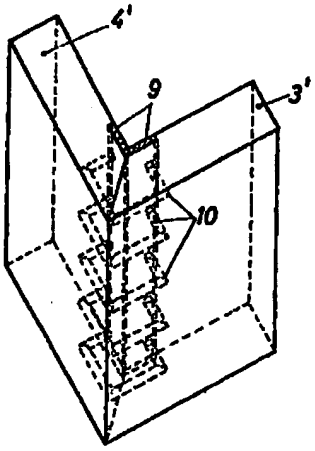

Fig. 5

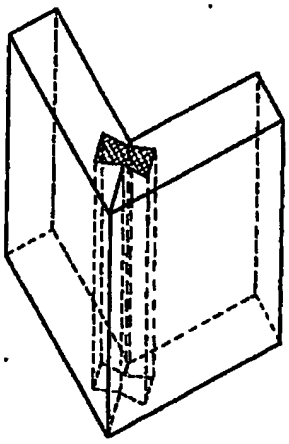

Fig. 6

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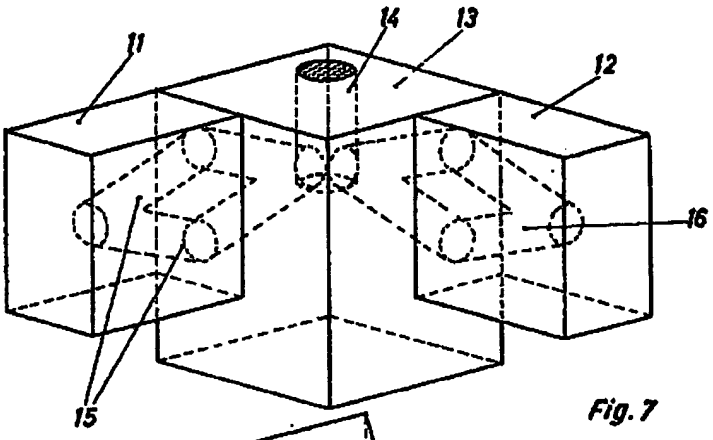

Fig. 7

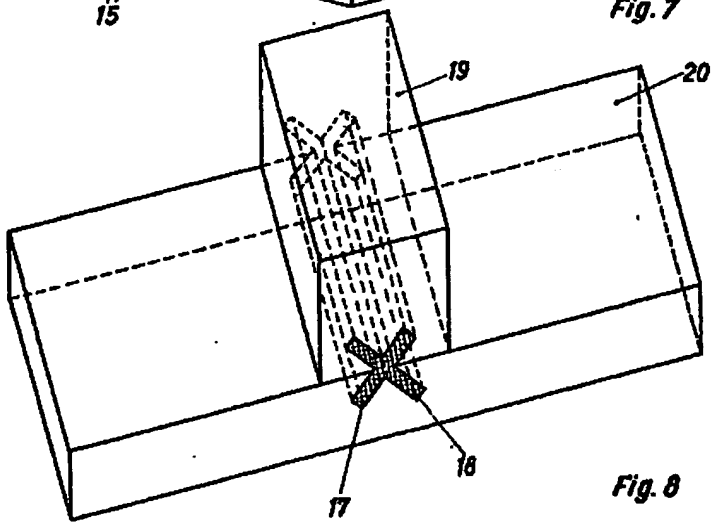

Fig. 8

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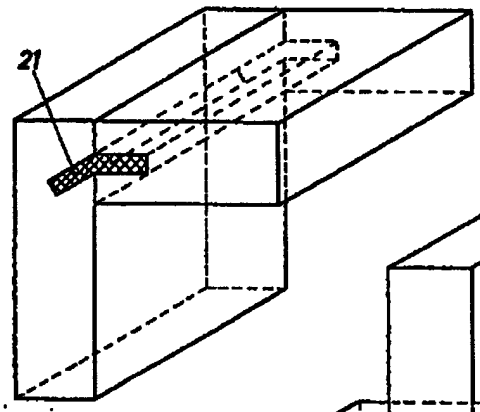

Fig. 9

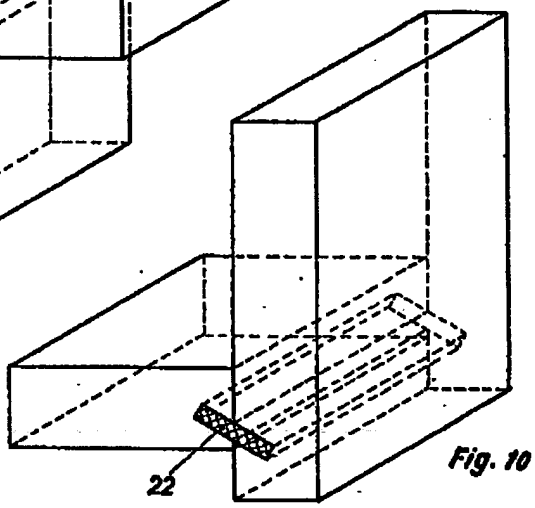

Fig. 10

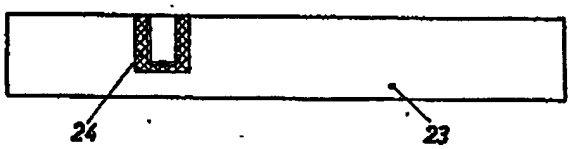

Fig. 11

1203305 COMPLETE SPECIFICATION
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Sheet 6

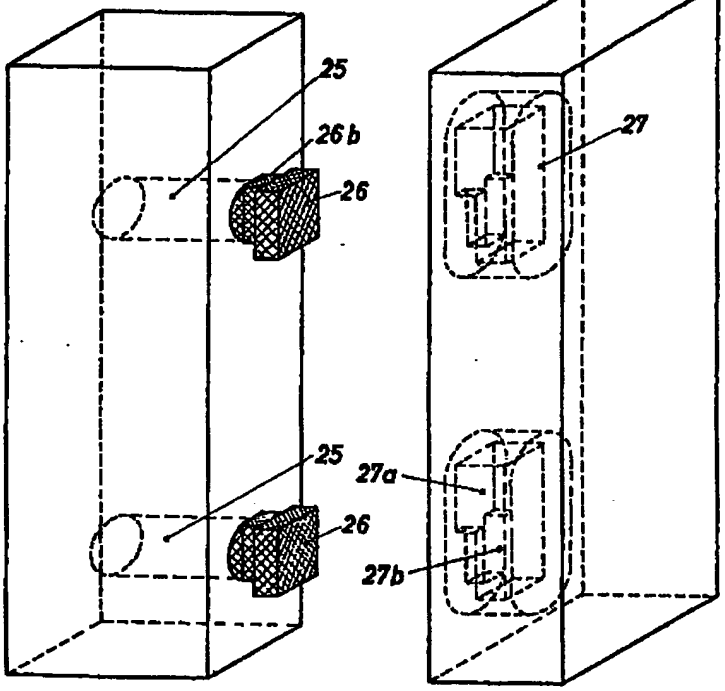

Fig. 12

Fig. 13